REMARKS

Claims 1-3, 5, 9, 10 and 12-16 are pending in this application. By this Amendment, Applicant amends the specification and claims 1, 2, 5, 9 and 10, cancels claims 4, 6-8 and 11, and adds claims 13-16.

The disclosure was objected to because of the informalities contained therein. Applicants have amended the specification to correct the informalities in the specification noted by the Examiner. Accordingly, Applicant respectfully requests reconsideration and withdrawal of this objection.

Claims 1-3 and 9-12 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Applicant's Admitted Prior Art (AAPA) in view of Cleeves (U.S. Patent No. 6,004,874). Applicant respectfully traverses this rejection.

Claim 1 has been amended to recite:

"A method of manufacturing an external force detection sensor comprising the steps of:

providing an element substrate;

forming a recess in a surface of the element substrate;

forming an etching stop layer of an electrically conductive material on the surface of the element substrate having the recess formed therein;

through-hole dry etching the surface of the element substrate using the etching stop layer;

forming a sensor element including a vibrating body, fixed electrodes and movable electrodes on the element substrate;

removing the etching stop layer; and

completing the manufacturing of the external force detection sensor." (Emphasis added)

Claims 2 and 16 recite similar features as claim 1 including those emphasized above.

The Examiner indicated that the recitation of "A method of manufacturing an external force detection sensor" has not been given patentable weight because the recitation occurs in the preamble. However, the body of Claims 1, 2 and 16 clearly recites steps that positively recite forming elements of an external force detection sensor including "forming a sensor element including a vibrating body, fixed electrodes and movable electrodes." Thus, the Examiner MUST give patentable weight to these

positive recitations of forming elements of an external force detection sensor.

With respect to AAPA, the Examiner admitted that AAPA "does not disclose that said etching stop layer comprises a titanium or aluminum electrically conductive material whose etch selectivity... is not less than 1." In fact, AAPA teaches a conventional method of forming an external force detection sensor, which like all other conventional methods of forming an external force detection sensor which use an etch stop layer, which must use an insulative material for the etch stop layer for the reasons described at page 5, last full paragraph, of the originally filed specification. There is absolutely no teaching or suggestion whatsoever in any prior art method of forming an external force detection sensor by using an electrically conductive material as the etch stop layer.

Nevertheless, the Examiner concluded that it would have been obvious to use the conductive metal etch stop layer of Cleeves with the method of forming an external force detection sensor of AAPA. Applicant strongly disagrees.

Cleeves is directed to a method of manufacturing a semiconductor device, NOT to a method of manufacturing an external force detection sensor. In addition, the etch stop layer of Cleeves is NOT removed from the substrate upon which it is formed at any time and certainly not before the final steps of completing the manufacturing of the semiconductor device. In fact, the ONLY reason why the etch stop layer is made of metal in Cleeves is in order to form a local interconnect between electrically conductive elements in the semiconductor device. The Examiner's attention is invited to Column 6, lines 12-34 of Cleeves. Thus, the etch stop layer could NOT be removed from the semiconductor device of Cleeves or else the desired electrical connection between two or more electrically conductive elements would be destroyed.

Accordingly, Cleeves clearly teaches away from Applicant's claimed invention and the combination proposed by the Examiner since Cleeves teaches that the etch stop layer is made of metal in order to form an electrical connection between elements and cannot be removed from the semiconductor device. Thus, Cleeves cannot be relied upon in an obviousness rejection of the present claimed invention since it is error to find obviousness where references diverge and teach away from the invention at

hand. W.L. Gore & Assoc. v. Garlock Inc., 721 F .2d 1540, 1550, 220 USPQ 303, 311 (Fed. Cir. 1983).

In addition, there would have been absolutely no motivation to combine Cleeves with AAPA as proposed by the Examiner since Cleeves is directed to a method of manufacturing a semiconductor device including using a conductive etch stop layer to form an interconnect layer. As noted above, the only reason why the conductive etch stop layer is used in Cleeves is to form an interconnect layer, which is completely unnecessary and undesirable in the method of AAPA.

Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination. In re Geiger, 815 F.2d 686, 2 USPQ 1276, 1278 (Fed. Cir. 1987).

At best, the Examiner's comments regarding obviousness amount to an assertion that one of ordinary skill in the relevant art would have been able to arrive at Applicant's invention because he had the necessary skills to carry out the requisite process steps. This is an inappropriate standard for obviousness. That which is within the capabilities of one skilled in the art is not synonymous with obviousness. See Ex Parte Levengood, 28 USPQ 2d 1300 (Bd. Pat. App. & Inter. 1993). The mere fact that the prior art could be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification. In re Gordon, 221 USPQ 1125 (Fed. Cir. 1984). As noted above, the prior art clearly teaches away from the combination proposed by the Examiner, instead of suggesting the combination.

Accordingly, Applicant respectfully submits that AAPA and Cleeves, taken individually or in combination, fail to teach or suggest the unique combination of method steps recited in claims 1, 2 and 16 of the present application.

In view of the foregoing amendments and remarks, Applicant respectfully submits that claims 1, 2 and 16 are allowable. Claims 3, 5, 9, 10, 12 and 13-15 depend upon claims 1 and 2, and are therefore allowable for at least the reasons that claims 1 and 2 are allowable.

Applicant has canceled non-elected claims 4 and 6-8, and further have modified

claim 5 and added claims 13-15 which depend upon claim 1, which the Examiner indicated was generic. Accordingly, Applicant respectfully submits that claims 5 and 13-15 should be allowed along with claim 1.

In view of the foregoing Amendments and Remarks, Applicant respectfully submits that this Application is in condition for allowance. Favorable consideration and prompt allowance are respectfully solicited.

To the extent necessary, Applicant respectfully petitions to extend the period for response by two months or until October 8, 2002 by the enclosed Petition for Two Month Extension of Time.

The Commissioner is authorized to charge any shortage in fees due in connection with the filing of this paper; including extension of time fees, to Deposit Account No. 50-1353.

Respectfully submitted,

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VERSION WITH MARKINGS SHOWING CHANGES MADE

IN THE SPECIFICATION:

In the angular velocity sensor (external force detection sensor) of the above-described constitution, a Coriolis force is generated in the Y-direction when the external force detection sensor is rotated about a Z-axis orthogonal to the direction of the X-Y plane in a condition where the oscillating body 5 is excitation-oscillated in the X-direction as described above. The Coriolis force is applied to the oscillating body 5, and the oscillating body 5 is oscillated in the direction of the Coriolis force. The clearance between the above-described movable electrodes 13 and fixed electrodes 14 is changed by the oscillation in the Y-direction of the oscillating body 5 attributable to the Coriolis force, and the electrostatic capacity between the movable electrodes and the fixed electrodes 14 is changed. The magnitude of the angular velocity of the rotation can be detected by detecting the electrical signal corresponding to the magnitude of the amplitude of the oscillation in the Y-direction of the oscillating body 5 generated by the above-described Coriolis force making use of the change in electrostatic capacity. Thus, the sensor element 1 of the angular velocity sensor illustrated in FIGs. [.] 6A and 6B forms a movable element having a movable part such as the oscillating body 5 and a support beam 7.

The etching stop layer 18 to be formed in manufacturing the external force detection sensor such as the angular velocity sensor has to be conventionally formed of an insulating material such as silicon oxide from the viewpoint of facilitation of forming a layer and simplification of a manufacturing process of the external force detection sensor. However, the inventor noticed that a notch (a profile distortion) is formed on a lower part side (i.e., a side on which the etching stop layer 18 is formed) of a side wall surface of the through holes 20 as illustrated in FIG. 7E since the etching stop layer 18 is formed of the insulating material as described above.

However, when [a] through holes 20A [is] are generated during the over etching as illustrated in FIG. 8B, the temperature of a part between the over etched through holes 20A (for example, a hole indicated by the reference numeral 21 in FIG. 8B) rises. That is, when the electrons in the etching gas collide with the side wall surface of the through hole during the over etching to generate heat, the hole 21 is thermally independent from other areas since the etching stop layer 18 is formed of the insulating material and its heat conductivity is very inferior, the heat is stored in the side wall surface of the hole 21, and the temperature of the hole 21 rises higher than the other areas. Thus, the hole 21 becomes easier to etch than the other areas, the etching removal is excessively achieved as indicated by a solid line while the true etching removal should be originally achieved to the dimension as indicated by a broken line in FIG. 8C, resulting in a part not being formed to the designed dimension because of the excessive etching.

IN THE CLAIMS:

1. A method of manufacturing an external force detection sensor [, which method includes] comprising the steps of:

providing an element substrate;

forming a recess in a surface of the element substrate;

forming an etching stop layer of an electrically conductive material on the surface of the element substrate having the recess formed therein;

through-hole dry etching [of an] the surface of the element substrate using [an] the etching stop layer [, wherein said etching stop layer comprises an electrically conductive material];

forming a sensor element including a vibrating body, fixed electrodes and movable electrodes on the element substrate;

removing the etching stop layer; and

completing the manufacturing of the external force detection sensor.

2. A method of manufacturing an external force detection sensor [, which comprises] comprising the steps of:

forming a recessed part on a back surface side of an element substrate[,];

forming a membrane on a face side[,];

providing an etching stop layer comprising an electrically conductive material on a top surface of the recessed part of said element substrate[,];

joining the back surface side of said element substrate with a support substrate[,]; and

forming a sensor element including a vibrating body, fixed electrodes and movable electrodes by dry etching of the membrane of said element substrate;

removing the etching stop layer; and

completing the manufacturing of the external force detection sensor.

5. A method of manufacturing an external force detection sensor according to claim [4] 13, wherein the dummy support substrate and the etching stop layer are removed after the sensor element is formed and, after that, a support substrate with a recessed part formed therein is arranged on a back surface side of said element substrate such that the recessed part of said support substrate is arranged opposite to the sensor element and, then the support substrate is joined with the element substrate.

9. A method of manufacturing an external force detection sensor according to claims 2, 3 or 5 [, 6, 7 or 8], wherein the element substrate is formed of a silicon material, the support substrate is formed of a glass material, and the element substrate is anodically joined with the support substrate.

10. A method of manufacturing an external force detection sensor according to one of claims 1, 2, 3 or 9 [to 8], wherein the etching stop layer is formed of an electrically conductive material whose etch selectivity which is the ratio of the dry-etch rate of an element substrate to the dry-etch rate of an etching stop layer is not less than 1.